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Sintonen, Sara

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From an experimental paper to a playful screen: How the essence of materiality modulates the process of creation

Sara Sintonen

Sara Sintonen works at the University of Helsinki, Faculty of Education Sciences as a senior lecturer. She holds the title of adjunct professor on media education (University of Helsinki) and on children's digital cultures (University of Turku). Address for correspondence: Sara Sintonen, Faculty of Educational Sciences, University of Helsinki, P.O. Box 9, 00014, Finland. Email: sara.sintonen@helsinki.fi

Abstract

The article seeks to develop a better understanding of the contribution of materiality in a discourse between a creator (content producer) and an interface, dealing with analogue and digital artefacts. Focus is in the materiality of the two different art-creation learning processes, acrylic painting and digital painting. The objective of this paper is to consider especially the affect and meaning of these two different content creation modalities and intra-action within that. Through reflective autoethnographic consideration, the purpose is to consider the essences of materials manifesting and modulating the processes of content creation as a posthumanist phenomenon. It will be shown that the creation processes with paper are more experimental whereas the processes with digital screen are more playful. There is a growing need to deeper understand the cultural change of material cultures and the people's intra-action with the materials also enabling arts creation. This paper will widen our limited understanding and deepen our theoretical perspectives of the essence of materials which then avails confronting analogue and digital when developing teaching and learning in the posthuman era especially in early education.

Introduction

This article works through thinking about a learner's experiences dealing with analogue and digital artefacts in order to explore the potential of different materials modulating content creation processes. The aim of this article is to develop a better understanding of the contribution of materiality in a discourse between a creator (content producer) and an interface, through the concept of *intra-action* (Barad, 2003, 2007). My argument rests on the belief that the basis of content creation is foundationally connected with the essence of materials modulating the dynamic processes: as analogue and digital technology have their own characteristic essences, they act differently as mediators, and in education one cannot replace another. As Karen Barad (2007, p. 170) formulated: "Matter's dynamism is generative not merely in the sense of bringing new things into the world but in the sense of bringing forth of new worlds, of engaging in an ongoing reconfiguration of the world." New materialism offers the viewpoint for processes emerging from several tangled relationalities (Barad, 2003, 2007). Therefore, it is worth addressing questions of (1) what digitalised education might come to look like in the ever-changing contexts of the rapidly changing technology and material conditions in a posthuman era and (2) what the matter is of

Practitioner Notes

What is already known about this topic

- There is a growing interest in the new materialism and posthuman thinking amongst educational technology research and development.
- Reading analogue versus digital is well-documented.

What this paper adds

- New materialist thinking offers a useful perspective in education for looking at the essence of analogue and digital materiality modulating content creation.
- Characterising the nuances in analogue and digital production can help in evaluating their educational potential.

Implications for practice and/or policy

- As practitioners we should critically question the political vision of education digitalisation especially concerning early childhood education.
- There is a need to move beyond debates about analogue versus digital to look at more specific examples of their advantages (and disadvantages) in developing posthumanist education and intra-active pedagogy especially for young children.

non-digital materials and the physical presence in digitalised future education. For these perspectives, autoethnography provides a considerable methodological viewpoint as it connects the personal to the cultural (eg, Starr, 2010).

One of the major transformative factors of the humanities at the beginning of the 21st century was the shift from analogue to digital sources. In earlier research, the focus has been mainly on usability and the amount of time of people use various digital devices. Currently, there is a growing need to explore the nuances of the interaction between creator and interface from the materiality point of view. People are engaging widely with digital devices, and using them for self-expression and content creation—even young children. Compared to digital devices like laptops, touch-screen tablets are currently the most popular devices and there is a growing trend amongst young children to have them (Livingstone, Marsh, Plowman, Ottovordemgentschenfelde, & Fletcher-Watson, 2014; Siegle, 2013), so it is critical to understand the potentials and constraints of such interactive devices. Also, for 0- to 2-year-old children, tablets are easy to use, because of their intuitive touch-based interface (Marsh *et al.*, 2015), as computers or non-digital tools (eg, pencils, brushes) require more complex fine motor skills to operate. Especially for young children, *touch* is an important feature in materiality scanning. Touch is a primary form of interaction, part of our sensory systems (Smith & Gasser, 2005) which provide an interrelated, multimodal experience of vision, hearing, touch, and action (see Crescenzi, Jewitt, & Price, 2014).

In education development, great emphasis and resources have been applied to digitalisation. This has been the case in Finnish education policies (see Saari & Säntti, 2018) and in many other countries. In Finland, the Minister of Education and Culture has frequently referred to the "digital leap," which means that kindergartens, schools, university teacher education, and in-service training should modernise their infrastructures, uses and pedagogy towards digital ecologies. Digitalisation has become a driving force in economic productivity and competitiveness all over the world (European Commission, 2016; OECD, 2015). Interestingly, as Finnish education has been focusing on change and moving (leaping) towards digitality and digital ecologies, discussions

and speculations dealing with analogue versus digital contain the idea of the digital *replacement* of education environments and materials (eg, Niemi, Kynäslahti, & Vahtivuori-Hänninen, 2013; Vahtivuori-Hänninen & Kynäslahti 2012). However, the analogue world is still there. Rather than seeing the digital and analogue as separate facets of the same world, we should start to consider how the essence of materiality is implicated with the digital, intangible, physical and material processes in which they are also inextricably entangled. Barad (2007) has emphasised relationality, intra-actions that occur within the entanglements of the phenomenon.

In thinking of digitalisation distancing one's perception of content, something being digital is often assumed to be immaterial. However, as Levy (2016) stated, the digital also has material existence:

> Paper documents, we often hear said, are real: physical, material, weighty, tangible. Whereas digital documents, by contrast, are virtual: immaterial, weightless, and intangible. With such pronouncements, I think we are trying to get at something important about the new technology, but we haven't yet gotten it right. Digital documents are *not* immaterial. The marks produced on screens and on paper, the sounds generated in the airwaves, are as material as anything in our world. (pp. 251–252)

Levy (2016) continued that in digital representations, the bits of a document are real and physical, and they have both a material and a symbolic existence. Through deepened understandings of their material articulations of the world, users, creators and learners construct new knowledge and thickened experiences, and they develop first-hand sensitivities to making that help them find the "causal structures" underlying what they do (Barad, 2007). Barad (2003) reworked the traditional notion of causality and explained how intra-action enacts an agential cut, a local resolution within the phenomena. This "knowing in being" can be transformative with regards to how a person interacts with and lives in the world (Garber, 2019).

Materiality in the posthuman era

New materialist thinking builds on the insight that "our material lives are always culturally mediated, but they are not only cultural" (Coole & Frost, 2010, p. 27) and it questions the primacy of language and social forms in constructing meanings, identities and even bodies. New materialisms have emerged as part of a material turn in the humanities. Stuff is not merely unruly, as Boscagli (2014) said in his *Stuff Theory*; it becomes the grounding of a new relation between people and matter that might be built. Referring to Boscagli, Oulanne (2018) considered how material turn is needed because constructions through language and culture leave little room for understanding the materiality of either human beings or the world. As Sakr (2017) annotated thinking only materiality as resources or affordances does not offer multidimensional focus enough to understand the state of constant creation and especially children's interactions with digital technologies.

New materialism relays matter as agentive, indeterminate, constantly forming in unforeseen ways (Coole & Frost, 2010). Matter is dynamic. In thinking of subject and object, the focus is typically on the relationship, but the new materialist thinking shifts the focus to their entanglement. There is something resonating in between, in *intra-action* (Barad, 2007): an interdependent collaboration amongst material and human actants that co-constitutes play, design and experimentation. Barad observed mutual relationality that things are because they are influencing each other. New posthuman materialist philosophies, and specifically Barad's relational materialist orientation, offer the potential to shift the ways in which we engage with analogue and/or digital content production. Barad's (2007) suggestion that "matter and meaning are mutually articulated" was originally leading me to consider a more material relation that emerges through

the intra-actions between creator and the interface (p. 152). Processes of works of art are a type of matter also.

In the field of design education and maker-learning, it is known that tangible objects mediate embodied thinking and act as material social mediators of knowledge creation processes. However, the material properties of the designed artefact and students' varying skills and levels of material knowledge, constrain the design process; material manipulation occurs during ideation (Yrjönsuuri, Kangas, Hakkarainen, & Seitamaa-Hakkarainen, 2019). The tangibility of the material working can be engaging and stimulating (Clapp, Ross, Ryan, & Tushman, 2016), and rich material resources can inspire imagination (Alesina & Lupton, 2010).

As touch technologies such as phones and tablets become more present within classrooms, there is a need to examine the relationship between creator and material, particularly amongst digital creative content production. Here, analogue and digital materiality do not define something done, but a process of becoming. They refer to the making and to what emerges of these entanglements, not to a state or a quality of matter. "The clay is a mode of thinking for the potter" (Oulanne, 2018, p. 25 referencing to Malafouris, 2008), and material things are incorporated in the human lived body and affective experience.

For Barad (2007) agency emerges when things and bodies come together: humans and nonhuman entities become agents only by way of each other. As Oulanne (2018) explained it, "There is no bicycle rider without a bicycle and a ground on which it can be ridden; these are features we add, in our interpretive imagination, to even fictional evocations of the event of bicycling. Equally, there is no reader without the nonhuman agencies of the text and the book, other environmental contributors of the event of reading, or the influence of its cultural and linguistic context" (p. 25). New materialisms such as Barad's agential realism offer a way to track bodies and things in unfolding relation within the emergent flows that play produces. The concept of intra-action reframes materiality from design affordance to a cycling interplay produced by the physicality, fluidity and messiness of entangled bodies, things and places (Wohlwend, Peppler, Keune, & Thompson, 2017, p. 447). "Matter is promiscuous and inventive in its agential wanderings: one might even dare say, imaginative," as Barad (2015) said (p. 287).

Paper or/and screen?

During the last few decades, there has been considerable interest in education research on the differences between paper and screen, especially in the field of literacy studies, mainly concentrating on the question of reading from a paper versus a screen. Scholars all over the world have published studies investigating how reading on a screen differs from reading on paper (eg, Mangen, Walgermo, & Brønnick, 2013; Myrberg & Wiberg, 2015; Willoughby, Evans, & Nowak, 2015) and these studies interest readers. Researchers have also been trying to explain the potential differences between reading on paper versus on screen from the material characteristics of the presentation medium viewpoint (eg, Hou, Rashid, & Lee, 2017). According to the meta-analysis comparing analogue and digital, more empirical evidence is needed on understanding the benefits of reading in print, digitally or in combination (Delgado, Vargas, Ackerman, & Salmerón, 2018; Singer & Alexander, 2017).

In testing of children's early literacy skills, tablet-based tests have the potential to improve assessment practices for research purposes and classroom use, and tablets have the potential to foster emergent writing and letter knowledge (Neumann & Neumann, 2017). Young children also develop a range of technical and operational skills through the use and exploration of tablets, when they learn how to unlock the device, navigate through interfaces, menu selection and using different touch gestures such as tap, drag, or swipe (Marsh *et al.*, 2015), and they are also able

to produce layered multimodal ensembles (Wohlwend, 2015). In one piece of research, the key findings showed that parents and teachers had a positive perspective of young children's use of tablets and viewed them as educationally valuable, although there were also concerns and a need for guidance for parents (Neumann, Merchant, & Burnett, 2018).

Walsh and Simpson (2013) have also examined touch and the dynamic materiality in literacy learning. Crescenzi, Jewitt, and Price (2014) researched the role of touch in preschool children's learning to use a digital mobile device (iPad) versus paper interaction. The researchers' focus was on comparing how touch features in painting with a tablet versus painting with paper. Crescenzi *et al.* (2014) found that digital mobile device may promote more and a wider variety of touch-based interaction, but the study also highlighted that digital devices have some "losses" that need to be considered especially in early education. Crescenzi *et al.* (2014) concluded that "touch in the iPad environment loses the sensation of touching paint as a medium, the messiness of finger-painting, and the moments of physical 'distance' and 'removal' produced in the rhythmic move from the paper as a site of interaction afforded by the need to constantly 're-apply' paint to the fingers" (pp. 92–93). Still, the study recommended material affordances for early education, as digital technology shapes young children's touch-based interactions, by engendering broader use of a wider range of types of touch. These include more complex and longer sequences of continuous touch interactions, and they foster more elaborate touch repertoires.

In thinking of children's writing with analogue versus digital environments and tools, it is known how the development and coordination of fine motor skills, neuromotor processes and multiple cognitive processes are essential in handwriting (eg, Dinehart, 2015). However, modern tablets with touchscreens have been found to be effective instructional tools for children with specific learning disabilities, improving their handwriting, spelling and composing competence (Berninger, Nagy, Tanimoto, Thompson, & Abbott, 2015). More generally, digital tools and activities have been shown to enhance learning in classroom learning, if the pedagogy behind actions is well planned: Räisänen, Korkeamäki, and Dreher (2016) highlighted how Finnish students in grade one (age 6–7) increasingly successfully engaged in a variety of digital and non-digital activities (read books, wrote emails, created an online shop).

Digital content benefits visual information, especially images. According to Chapman, Hall, Colby, and Sisler (2014), images can do much more than stimulate a conversation—they can "evoke engagement, openness, receptivity, awareness, connection, emotional responses, empathy/perspective-taking, attitude and behaviour change" (Chapman *et al.*, 2014, p. 470). Various modalities as material resources and affordances in technological environments are important in fostering communication and creativity, and extending children's skill sets. For example, according to one study, digital painting allows children to practise their own creation freely, without being concerned about making mistakes or wasting paper (Ho & Lin, 2015, p. 38). In order to understand better what digitalised education might come to look like in the ever-changing contexts of the rapidly changing technology, new material conditions and text worlds, and what's the matter is of non-digital materials and the physical presence in education, it is worth considering the essence of materiality in an intra-action of a creator and an interface. It is obvious that the engaging and multimodal features of modern digital tools afford a range of opportunities for fostering learning and self-expression. In the posthuman era, new material thinking is looking for something more intertwined, inseparable.

A researcher's autoethnographic orientation from an experimental paper to a playful screen

An autoethnographic, performative narration is an option for a researcher cogitating embodied practices between the subject and object (eg, Vu, 2018), connecting the personal to the

cultural (eg, Starr, 2010). My learner and user experiences in the field of painting on paper with acrylic paint and painting with a digital application on a mobile phone screen, provides the autoethnographic platform for developing a notion of "experimental paper and playful screen," which I describe here through analytical self-reflection, to characterise the processes. I go on to illustrate the essence of materiality modulating the process of creation, by looking through and considering several aspects and dimensions. Sense refers to making meaning with things through sign-making representation (see Wohlwend *et al.*, 2017), while essence turns the view to the materials' demeanour referring to "the intrinsic nature or indispensable quality of something, especially something abstract, which determines its character" (Lexico, 2019).

I decided to adapt autoethnography, which is a self-reflexive, qualitative research method (Crouch, 2007; Ngunjiri, Hernandez, & Chang, 2010; Vu, 2018), draws upon postmodern sensibilities (Anderson, 2006), and is ethical, analytical and theorised (Stephens Griffin & Griffin, 2019). Autoethnography reflexivity refers to the mutually affecting or cyclic relationship between cause and effect. This orientation turned out to be reasonable because my main interest was the intra-action of the creator and the material. Being reflexive as a researcher enables one to look beyond the established paradigm (Crouch, 2007, p. 109) and is not an added effort, but a "state of mind" (Bolton, 2010, p. 3). Autoethnography is also said to be directed towards dialogue and critical thinking, and it offers "lessons for further conversation rather than undebatable conclusions," as Ellis and Bochner (2000) pointed out (p. 744).

After various self-learning phases with both digital and analogue painting, I went to a group in order to learn the basics of acrylic painting. After that, I again became interested in digital art and wanted to learn how to create paintings digitally. I decided to continue my work on my mobile phone and nowadays I work mainly with it, though I really enjoy both ways of creating art. Over the years I have kept a written journal of my experiences because I am used to putting my own thoughts in a diary and the art teacher advised us to do so. Typically, these are hand-written short phrases at the edge of my calendar or notes in my sketch notebook.

The written notes became "data," allowing me as the researcher to extract them in an analytical manner. I collected all the calendar and notebook remarks (from 2015 to 2019) into one file and scoured them for common threads and key phrases or concepts. In order to organise and more deeply consider the written thoughts, I left out the irrelevant remarks (eg, "missing the class") and notated 22 separate codes in the data. After searching for connective points and similar features, I marked the eight key concepts: rearrangement, mobility, perception, contact, sensation, dynamics, play and experience. Then I started to write a narrative, descriptive summary representing various modulations the essence of materiality causes.

Experimental and playful

Working with paper resonates as a more physical activity. For example, as the situation or mood changes, the painting supplies can be moved from one place to another, from a desk to the floor, as I did during few classes.

> I probably looked funny with my whole body swaying along. Finally, I had to place the work on the floor and be almost on top of it. [10/2016]

Although mobile devices may also enable one to change the workplace, it does not allow the same kind of rearranging as described above. According to my own experiences, analogue rearranging is then more connected to bodily aspects (modifying the physical working place and space), as digital rearranging is the mobility of the person carrying the device.

It's like my own secret life on my mobile phone, it's with me right there all the time. It kind of reminds me, hey, should we play again? Wonderfully thrilling. Don't have to show everything to others. [3/2019]

With analogue work, from a physical point of view, I often feel being more in direct contact with the material and for example, I can spill the paint onto my skin and clothing. Perhaps the touch of the paint even helps me to evoke imagery and emotion. As for digital work, traces form on the screen in the form of electronic data, but this is not tangible or flowing, and thus cannot be mixed with other physical materials.

I drove home and looked at my hands around the steering wheel. Despite the darkness, I could see that my fingers were totally black. At least I've painted today, you can tell. I sort of want to leave these unwashed. [11/2018]

Feeling a bit embarrassed about splattering all that paint. I just had to give up the brush and paint by hand. [9/2015]

I can't stand how difficult this is. I'd like to rip up and throw the paper in the bin, but the teacher won't let me. They need to be kept, I hear, to learn to see. I threw it in the bin on the car park. [3/2016]

In digital work, a blank screen represents a blank sheet of paper. On the screen I can work on the artwork in layers, and the actions with layers transform the object, and the process is dynamic: I can often revert, rearrange, change, add, and modify the layers of work in many ways. With analogue work, the layering is more distinct, and, in principle, it is irreversible once the work has been done in an incremental order. Additionally, the scalability of a digital screen creates a totally different dynamic viewpoint for a creator, and I found myself to be amused about this technical feature.

I've clearly developed in the use of layers, it's fun to try out different things. Today I also found the dimming button, I played around with that. [9/2018]

I love the fact that the screen is scalable. It's almost being able to dive into my own painting. [11/2018]

Analogue, traditional painting results in an object that is typically regarded as uniquely produced by the artist, stable in nature. The art work's existence is perceptible, it being able to capture the attention of others. In digital work, the finished creation is saved and can be shared, and printed if necessary, so it also has the nature of an object.

The teacher told us to put all our work on the wall. And then others commented on them. Pretty awful, I felt completely bare and strange at the same time. [5/2017]

When a work produced by analogue means is placed on display, the focus also turns to an awareness of the different ways in which technical skills are more involved. In this situation, I realised how the material also has its own language, which is associated with certain images, such as those based on traditions. In analogue work, I am aware that material-related sensations also have an influence, as the materials have sensory attributes such as aroma, feel and texture. In digital work, as a learner I am not so dependent on skill, as working on the screen allows for different testing and I can revert numerous times. With the analogue method, I have learnt how the materials often limit the duration of work, because the paint as material changes its state as it dries, for example. Analogue material necessitates something beforehand (when the brush touches the paper, the moment is in there) with the feeling of irreversibleness, whereas digital emerges in a much more back and forth way in a dynamic sense.

Today the paper was somehow totally rugged. I could see with the very first stroke that I wouldn't be able to hide those "lumps". I tried to incorporate them in the piece, but that didn't work out at all. It looked even more hideous when it was dry. [11/2016]

It turned out super great in my opinion. I did it in one sitting. If you went back through all the phases, there would probably be a hundred different versions underneath. [11/2018]

For me the digital way of working can also be described as peeking, sounding or searching. I can play and experiment on the screen without great expectations—there are no failures as such, because one can always undo and replace one thing with another. This feels liberating. In principle, analogue is more restricted as it is not reversible, although any kind of experimentation is possible. As one might expect, this can lead to the creator becoming frustrated with the work when the expectation and the final product do not match. The digital way of creating is searching and playing, even if I already had a sketch in mind.

I downloaded a new app and this is so great. A couple hours went by in a flash. This has never felt so fun. [8/2018]

Variations! The best practise is to make many copies of own work and modify them. [3/2019]

It is notable in these self-reflective characterisations how frustration and inspiration, seriousness and play intertwine in an interplay between the creator and the interface. Materiality was not a limitation but set the certain frames for the interplay—as *material invitation* (as I call it) differed, it gave various impulses to me as a learner. Analogue seems to invite an embodied, sensory and experimental orientation as digital proposes for experimental playfulness—although these elements strongly overlap.

As posthuman and new materialism perspectives position people's meaning-making as something which is in a constant state of becoming (Barad, 2003), not a linear process, it has been relevant to ask "what is occurring here," and being aware of the inseparable materiality dynamics. I now turn to closer consideration of the educational implications of processing of two different, two-dimensional flat interfaces: paper and a screen, and what is enabling in both.

The essence of material modulating the processes: Implications for education

Characterising the nuances in analogue and digital production can help in evaluating their material potential for educational purposes, and a posthumanist reconsideration of the user-technology intra-actions open up a new and interesting opportunities for developing digital pedagogies. Still, as materials are in intra-action with the creator/user, further studies and deeper analyses are needed to research the role of materials as drivers of processes through which people learn. "Objects, materials, and the processes surrounding them have roles in the decisions and choices we make in our lives," said Garber (2019, p. 3). Barad (2007, 2015) emphasised mutual relationality: things are, because they are in relation to and influence each other. This is a premise from which conclusions should be drawn; I have asked what digitalised education might come to look like in the ever-changing contexts of the rapidly changing technology and material conditions, and what the matter is of non-digital materials and the physical presence in education.

Especially in early childhood education, psychology is still the dominant discipline and early education is based on institutionalised ageist practices (eg, File, Mueller, & Basler Wisneski, 2012). In this orientation, knowledge is acquired through the *representation* of a world, not *immersion*, thereby presupposing a language/reality dualism: sign systems created by humans represent a world inhabited by independently existing, passive objects without agency (eg, Murris, 2016). How we interact with materials in education will depend on the affective, physical and social relationships we have with the tools and technologies involved. "It must be recognized that when physically engaging with a screen or touchpad, children are interacting with a single surface type, while non-digital art-making is likely to involve a breadth of sensory experiences"

(Sakr, 2017, p. 25). Kress (2005) also commented that in using digital interfaces, one might lose sensory and somatic experiences, which should still be given emphasis in early learning. However, as Sakr (2017) noticed, the physical aspect of the experience is also of vital importance in digital art-making, especially when dealing with children. The research said, "If children have the physical freedom to use their whole body rather than just their hands, the experience of digital art-making will be different. This makes the details of the physical set-up of the environment in which digital art-making occurs particularly important" (Sakr, 2017, p. 13).

Garber (2019) stated that the intra-actions are what we must take into account. "Objects and materials have effects on makers and viewers when they find the smooth spaces between making and materials, among objects, and within interactions between them" (Garber, 2019, p. 12). Not all the material intra-act similarly. As presented here, analogue and digital present various things, invite different echoes and form their unique smooth intra-active spaces, emergent processes. Still, it is evident that analogue (in this study, traditional painting) and digital (mobile phone) creation processes cannot be separated, as one supports the other. The key question will be how we articulate dialogue within the material and new materialism in educational practice. Deeper considerations of the ways how learners are invited by various material essences and within intra-active relations, are needed. This will hopefully lead pedagogy to be continually created through the relationalities of materialism.

Conclusion

There is an urgent need to consider more deeply the future posthuman intra-active pedagogies and smooth spaces, a thinking without representationalism (eg, Murris, 2016), and enhance intra-actions as such. If the matter is promiscuous, inventive and imaginative in its agential wanderings, as Barad (2015) taught us, unforeseen smooth spaces and material invitations will then be the key pedagogical focus. For example, creativity constitutes the remaking of existing materials; therefore, material affordances are not meaningless (Wohlwend *et al.*, 2017), and thinking further, affordances need be considered to be active encounters. Considering analogue and digital material recourses and technologies as competing assets is not relevant; from the material point of view, analogue and digital represent various things, have their own characteristic essences and act differently in intra-action, therefore in education one cannot replace another. This leads us to the new interesting educational technology perspectives and challenges us to think about digital touch experiences and material interactions beyond a screen.

When a person touches a piece of paper or a screen, they are also touched by it. Future education needs to be materialised in sensory, embodied, experimental and playful intra-actions. Furthermore, in future education the essences of materiality need to be implicated and researched with the digital, intangible and physical processes in which it is inextricably entangled. The material world of *versus* becomes *aligned with*.

Statements on open data, ethics and conflict of interest

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

There are no conflicts of interest to disclose.

The research has been conducted following the ethical principles of the University of Helsinki.

References

Alesina, I., & Lupton, E. (2010). *Exploring materials: Creative design for everyday objects*. New York, NY: Princeton Architectural Press.

Anderson, L. (2006). Analytic Autoethnography. *Journal of Contemporary Ethnography*, *35*(4), 373–395.

Barad, K. (2003). Posthumanist performativity. Toward an understanding of how matter comes to matter. *Signs*, *40*(1), 801–831.

Barad, K. (2007). *Meeting the universe halfway: Quantum physics and the entanglement of matter and meaning*. Durham, NC: Duke University Press.

Barad, K. (2015). Transmaterialities. Trans*/matter/realities and queer political imaginings. *GLC: Journal of Lesbian and Gay Studies*, *21*(2–3), 387–422.

Berninger, V. W., Nagy, W., Tanimoto, S., Thompson, R., & Abbott, R. D. (2015). Computer instruction in handwriting, spelling, and composing for students with specific learning disabilities in grades 4–9. *Computers & Education*, *81*, 154–168.

Bolton, G. (2010). *Reflective practice: Writing and professional development*. Thousand Oaks, CA: Sage.

Boscagli, M. (2014). *Stuff theory: Everyday objects, radical materialism*. New York, NY: Bloomsbury.

Chapman, M. V., Hall, W. J., Colby, R., & Sisler, L. A. G. (2014). How images work: An analysis of a visual intervention used to facilitate a different conversation and promote understanding. *Qualitative Social Work*, *13*(4), 456–476. https://doi.org/10.1177/1473325013496597

Clapp, E. P., Ross, J. O., Ryan, J., & Tushman, S. (2016). *Maker-centered learning: Empowering young people to shape their worlds*. San Francisco, CA: Jossey-Bass.

European Commission (2016). *The importance of the digital economy*. Retrieved from http://ec.europa.eu/growth/sectors/digital-economy/importance/index_en.htm

Coole, D., & Frost, S. (2010). Introducing the new materialisms. In D. Coole & S. Frost (Eds.), *New materialisms: Ontology, agency, and politics* (pp. 1–43). Durham, England: Duke University Press.

Crescenzi, L., Jewitt, C., & Price, S. (2014). The role of touch in pre-school children's learning using iPad versus paper interaction. *Australian Journal of Language and Literacy*, *27*(2), 86–95.

Crouch, C. (2007). Praxis and the reflexive creative practitioner. *Journal of Visual Art Practice*, *6*(2), 105–115. https://doi.org/10.1386/jvap.6.2.105_1

Delgado, P., Vargas, C. L., Ackerman, R., & Salmerón, L. (2018). Don't throw away your printed books: A meta-analysis on the effects of reading media on reading comprehension. *Educational Research Review*, *25*, 23–38. Retrieved from https://www.sciencedirect.com/science/article/pii/S1747938X18300101

Dinehart, L. (2015). Handwriting in early childhood education: Current research and future implications. *Journal of Early Childhood Literacy*, *15*(1), 97–118.

Ellis, C., & Bochner, A. P. (2000). Autoethnography, personal narrative, reflexivity. Researcher as subject. In N. K. Denzin, & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 733–767). Thousand Oaks, CA: Sage.

File, N., Mueller, J. J., & Basler Wisneski, D. (2012). *Curriculum in early childhood education. Re-examined, rediscovered, renewed*. New York, NY: Routledge.

Garber, E. (2019). Objects and new materialisms: A journey across making and living with objects. *Studies in Art Education*, *60*(1), 7–21. https://doi.org/10.1080/00393541.2018.1557454

Ho, T. K.-L., & Lin, H.-S. (2015). A web-based painting tool for enhancing student attitudes toward learning art creation. *Computers & Education*, *89*, 32–41. https://doi.org/10.1016/j.compedu.2015.08.015

Hou, J., Rashid, J., & Lee, K. M. (2017). Cognitive map or medium materiality? Reading on paper and screen. *Computers in Human Behavior*, *67*, 84–94. https://doi.org/10.1016/j.chb.2016.10.014

Kress, G. (2005). Gains and losses: New forms of text, knowledge and learning. *Computers and Composition*, *22*(1), 5–22.

Levy, D. M. (2016). *Scrolling forward. Making sense of documents in the digital age* (2nd ed.). New York, NY: Arcade Publishing.

Lexico. (2019). *Definition of 'essence' in English*. Retrieved from https://www.lexico.com/en/definition/essence

Livingstone, S., Marsh, J., Plowman, L., Ottovordemgentschenfelde, S., & Fletcher-Watson, B. (2014). *Young children (0–8) and digital technology: A qualitative exploratory study national report—UK*. Luxembourg: Joint Research Centre, European Commission. Retrieved from http://eprints.lse.ac.uk/60799/

Malafouris, L. (2008). At the potter's wheel: An argument for material agency. In C. Knappett & L. Malafouris (Eds.), *Material agency: Toward a non-anhropocentric approach* (pp. 19–36). Dordrecht, the Netherlands: Springer.

Mangen, A., Walgermo, B. R., & Brønnick, K. (2013). Reading linear texts on paper versus computer screen: Effects on reading comprehension. *International Journal of Educational Research*, *58*, 61–68. https://doi.org/10.1016/j.ijer.2012.12.002

Marsh, J., Yamada-Rice, D., Bishop, J., Lahmar, J., Scott, F., Plowman, L., & Winter, P. (2015). *Exploring play and creativity in pre-schoolers' use of apps: Technology and play*. Economic and Social Research Council. Retrieved from http://www.techandplay.org/tap-media-pack.pdf

Murris, K. (2016). *The posthuman child: Educational transformation through philosophy with picturebooks*. London, UK: Routledge.

Myrberg, C., & Wiberg, N. (2015). Screen vs. paper: What is the difference for reading and learning? *Insights*, *28*(2), 49–54. https://doi.org/10.1629/uksg.236

Neumann, M. M., Merchant, G., & Burnett, C. (2018). Young children and tablets: The views of parents and teachers. *Early Child Development and Care*, 1–12. https://doi.org/10.1080/03004430.2018.1550083

Neumann, M. M., & Neumann, D. L. (2017). The use of touch-screen tablets at home and pre-school to foster emergent literacy. *Journal of Early Childhood Literacy*, *17*(2), 203–220. https://doi.org/10.1177/1468798415619773

Ngunjiri, F. W., Hernandez, K. C., & Chang, H. (2010). Living autoethnography: Connecting life and research [Editorial]. *Journal of Research Practice*, *6*(1). Retrieved from http://jrp.icaap.org/index.php/jrp/article/view/241/186

Niemi, H., Kynäslahti, H., & Vahtivuori-Hänninen, S. (2013). Towards ICT in everyday life in Finnish Schools: Seeking conditions for good practices learning. *Media & Technology*, *38*(1), 57–71.

OECD. (2015). *OECD digital economy outlook 2015*. Paris, France: Author. https://doi.org/10.1787/9789264232440-en

Oulanne, L. (2018). *Lived things: Materialities of agency, affect and meaning in the short fiction of Djuna Barnes and Jean Rhys* (Academic dissertation). University of Helsinki, Faculty of Arts. Retrieved from https://helda.helsinki.fi/bitstream/handle/10138/234783/LivedThi.pdf?sequence=1&isAllowed=y

Räisänen, S., Korkeamäki, R.-L., & Dreher, M. J. (2016). Changing literacy practices according to the Finnish core curriculum. *European Early Childhood Education Research Journal*, *24*(2), 198–214. https://doi.org/10.1080/1350293X.2014.996421

Saari, A., & Säntti, J. (2018). The rhetoric of the 'digital leap' in Finnish educational policy documents. *European Educational Research Journal*, *17*(3), 442–457. https://doi.org/10.1177/1474904117721373

Sakr, M. (2017). *Digital technologies in early childhood art. Enabling playful experiences*. London: Bloomsbury.

Siegle, D. (2013). iPads: Intuitive technology for 21st-century student. *Gifted Child Today*, *36*(2), 146–150.

Singer, L. M., & Alexander, P. A. (2017). Reading on paper and digitally: What the past decade of empirical research reveal. *Review of Educational Research*, *87*(6), 1007–1041. https://doi.org/10.3102/0034654317722961

Smith, L., & Gasser, M. (2005). The development of embodied cognition: Six lessons from babies. *Artificial Life*, *11*, 13–29.

Starr, L. J. (2010). The use of autoethnography in educational research: Locating who we are in what we do. *Canadian Journal of New Scholarship in Education/Revue canadienne des jeunes chercheures et chercheurs en éducation*, *3*(1). Retrieved from https://jmss.org/index.php/cjnse/article/view/30477

Stephens Griffin, N., & Griffin, N. (2019). A millenial methodology? Autoethnographic research in do-it-yourself (DIY) punk and activist communities. *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research*, *20*(3), 3. http://dx.doi.org/10.17169/fqs-20.3.3206

Vahtivuori-Hänninen, S., & Kynäslahti, H. (2012).ICTs in a school's everyday life: Developing the educational use of ICTs in Finnish schools of the future. In H. Niemi, A. Toom, & A. Kallioniemi (Eds.), *Miracle of education: The principles and practices of teaching and learning in Finnish schools* (pp. 237–248). Rotterdam, the Netherlands: Sense Publishers.

Vu, C. (2018). New materialist auto-ethico-ethnography: Agential-realist authenticity and objectivity in intimate scholarship. *Decentering the researcher in intimate scholarship* (Advances in research on teaching, Vol. *31*, pp. 75–89). Bignley: Emerald Publishing.

Walsh, M., & Simpson, A. (2013). Touching, tapping…thinking? Examining the dynamic materiality of touch pad devices for literacy learning. *Australian Journal of Language and Literacy*, *36*(3), 148–157.

Willoughby, D., Evans, M. A., & Nowak, S. (2015). Do ABC eBooks boost engagement and learning in preschoolers? An experimental study comparing eBooks with paper ABC and storybook controls. *Computers & Education*, *82*, 107–117. https://doi.org/10.1016/j.compedu.2014.11.008

Wohlwend, K. (2015). One screen, many fingers: young children's collaborative literacy play with digital puppetry apps and touchscreen technologies. *Theory Into Practice*, *54*(2), 154–162. https://doi.org/10.1080/00405841.2015.1010837

Wohlwend, K. E., Peppler, K. A., Keune, A., & Thompson, N. (2017). Making sense and nonsense: Comparing mediated discourse and agential realist approaches to materiality in a preschool makerspace. *Journal of Early Childhood Literacy*, *17*(3), 444–462. https://doi.org/10.1177/1468798417712066

Yrjönsuuri, V., Kangas, K., Hakkarainen, K., & Seitamaa-Hakkarainen, P. (2019). The roles of material prototyping in collaborative design process at an elementary school. *Design and Technology Education*, *24*(2), 141–162.